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Original Article

Needlescopic Management of Hydrocele in Pediatric Age Group; Randomized Controlled Study

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ABSTRACT

Background: Hydrocele is an abnormal collection of fluids along the course of the processus vaginalis due to incomplete obliteration. So, closure of the patent processus vaginalis [PPV] may be the most effective way to prevent recurrence. Traditional open repair entails high ligation of the PPV and draining the fluid or window created in the tunica vaginalis. However, Laparoscopic closure of the internal orifice of the PPV became an option for the treatment of hydroceles in children. Needlescopic hydrocelectomy is considered a novel technique for hydrocelectomy in children

Aim of the work: This study aimed to evaluate the safety and efficacy of Needlescopic hydrocelectomy in managing congenital hydrocele in children

Patients and Methods: An RCT included 40 children with communicating hydrocele attending the Pediatric Surgery Department, Al-Azhar University Hospital in [Damietta and Cairo]. The recruited children were equally and randomly separated into two groups [Needlescopic hydrocelectomy and traditional /open method]

Results: The present study participants' age ranges from 2 to 7 years. The operative time in the Needlescopic group ranges from 31 to 45 min, with a mean of 37.3 min. In contrast, the open group ranges from 28 to 45 minutes, with a mean of 34.8 minutes [P=0.1]. The open group showed a significant incidence of scrotal edema and groin swelling. The Needlescopic group had a significantly higher cosmetic appearance than the open group.

Conclusion: Overall, the Needlescopic procedure is simple, safe, and effective in managing hydroceles in the pediatric population.

Keywords: Needlescopic; Hydrocele; Cosmetic; Open Surgery

INTRODUCTION

A hydrocele is an unusual accumulation of fluid along the pathway of the processus vaginalis resulting from inadequate obliteration [1]. Remaining patent processus vaginalis [PPV] is a common cause of hydrocele in pediatric patients, representing more than 60 percent of cases in infants. The ligation of the PPV may be the most effective means of avoiding recurrence [2]. Conventional open hydrocelectomy involves making a transverse inguinal incision, exploring the inguinal canal, conducting high ligation of the patent processus vaginalis, and withdrawing the fluid or cavity formed in the tunica vaginalis [3]. Nonetheless, laparoscopic closing of the internal opening of the patent processus vaginalis has emerged as a viable treatment for hydroceles in pediatric patients [4].

The conventional open hydrocelectomy, though effective, involves a larger incision and potential postoperative complications such as scrotal edema, groin swelling, and poor cosmetic outcomes. Recent advancements in laparoscopic surgery have introduced minimally invasive techniques that aim to improve patient recovery and reduce complications [3, 4]. Needlescopic hydrocelectomy is considered a novel technique for hydrocelectomy in children, and to date, no previous study has evaluated the safety and efficacy of needlescopic hydrocelectomy in children [5].

We hypothesize that needlescopic hydrocelectomy provides a safer and more effective alternative to conventional open hydrocelectomy in pediatric patients, leading to reduced postoperative complications, improved cosmetic outcomes, and comparable recurrence rates.

This study aimed to assess the safety and efficacy of needlescopic hydrocelectomy in managing congenital hydrocele in children.

PATIENTS AND METHODS

Study Design and Setting: This prospective randomized controlled study included patients with communicating hydrocele attending the Pediatric Surgery Department, Al-Azhar University Hospital in New Damietta, submitted for needlescopic hydrocelectomy.

Sample/Participants: In this study, we include children with communicating hydrocele after one year. And exclude Children with Hydroceles one year before, Hematocele, pyocele, recurrent hydrocele or non-communicating hydrocele.

Sample size: We recruited 40 children who matched the recruiting criteria and randomly separated them into two groups by shuffled sealed opaque envelope method. The first [Group A] included 20 children underwent needlescopic hydrocelectomy, while Group B included 20 children underwent traditional /open method

All participants were subjected to the following:

Preoperative assessment includes full history taking and assessment of the inguinoscrotal region at recruitment. Usual preoperative laboratory investigation. Inguinoscrotal ultrasonography to confirm presence of communicating hydrocele.

Surgical Procedures:

Needlescopic method [Figure 1]: There is a very minimal invasive technique using instruments [Suture grasper device [SGD], Epidural needle [EN], Long isolated homemade diathermy probe [DP] and handle of diathermy]

With the patient under general anaesthesia and in the flat supine position, the surgeon and cameraman were positioned at the patient's head, while the monitor was located at the foot of the operating theater. A trans-umbilical transverse incision was performed, and a 3-mm trocar for the scope was introduced and affixed to the abdomen wall. Pneumo-peritoneum was initiated, subsequently leading to the exploration of the abdominal cavity and bilateral internal inguinal rings [IIR]. Subsequently, two supplementary working instruments [DP and SGD] were introduced under direct visualization at the midpoint of the symphysis pubis and umbilicus, along the [right or left] midclavicular line, inferior to the umbilical level. The morphology of the internal inguinal ring on the same side was assessed laparoscopically and classified according to the type of hydrocele. The internal inguinal ring was dissected, and the hydrocele was excised entirely, extending as far as practicable elsewhere the restricted region to avert recurrence in the remaining sac. The conjoint tendon was stitched to the ilio-pubic tract, and the peritoneum was re-incised. The patients were discharged home on the same day and received weekly follow-ups throughout the initial month, followed by further follow-ups at three and six months.

Open hydrocelectomy: In the inguinal approach, the aponeurosis of the external abdominal oblique muscle is horizontally incised 1–2 cm superior to the external inguinal ring, extending 2–3 cm down the spermatic cord towards the internal ring. The chord structures are removed from the PPV. The transverse fascia is maintained. The PPV is after that firmly closed with absorbable suture [Vycril™ 3-0]. After closure, the PPV is resected above the suture. Upon conclusion of the procedure, the wound is sutured in anatomical strata. In the case of a bilateral hydrocele, the same treatment was completed on the opposite side.

Outcome measures: Recurrence rate [presence of hydrocele at 6 months postoperative] Postoperative complications [scrotal edema, groin swelling, wound infection]

Follow-up plan: the patients were assessed on the first day postoperative, then after one month, three months and six months

Data Analysis: Statistical analysis was accomplished using SPSS statistical software, version 27. Qualitative data were expressed as numerical values and percentages, analyzed using the Chi-square test, whilst quantitative data were represented as means and standard deviations, assessed by the independent t-test. The p-value was deemed significant at the threshold of <0.05.

Ethical approval:

The local ethical committee of Al-Azhar University, Damietta Faculty of Medicine, approved this study. Caregivers of each participant had to sign an informed consent form.

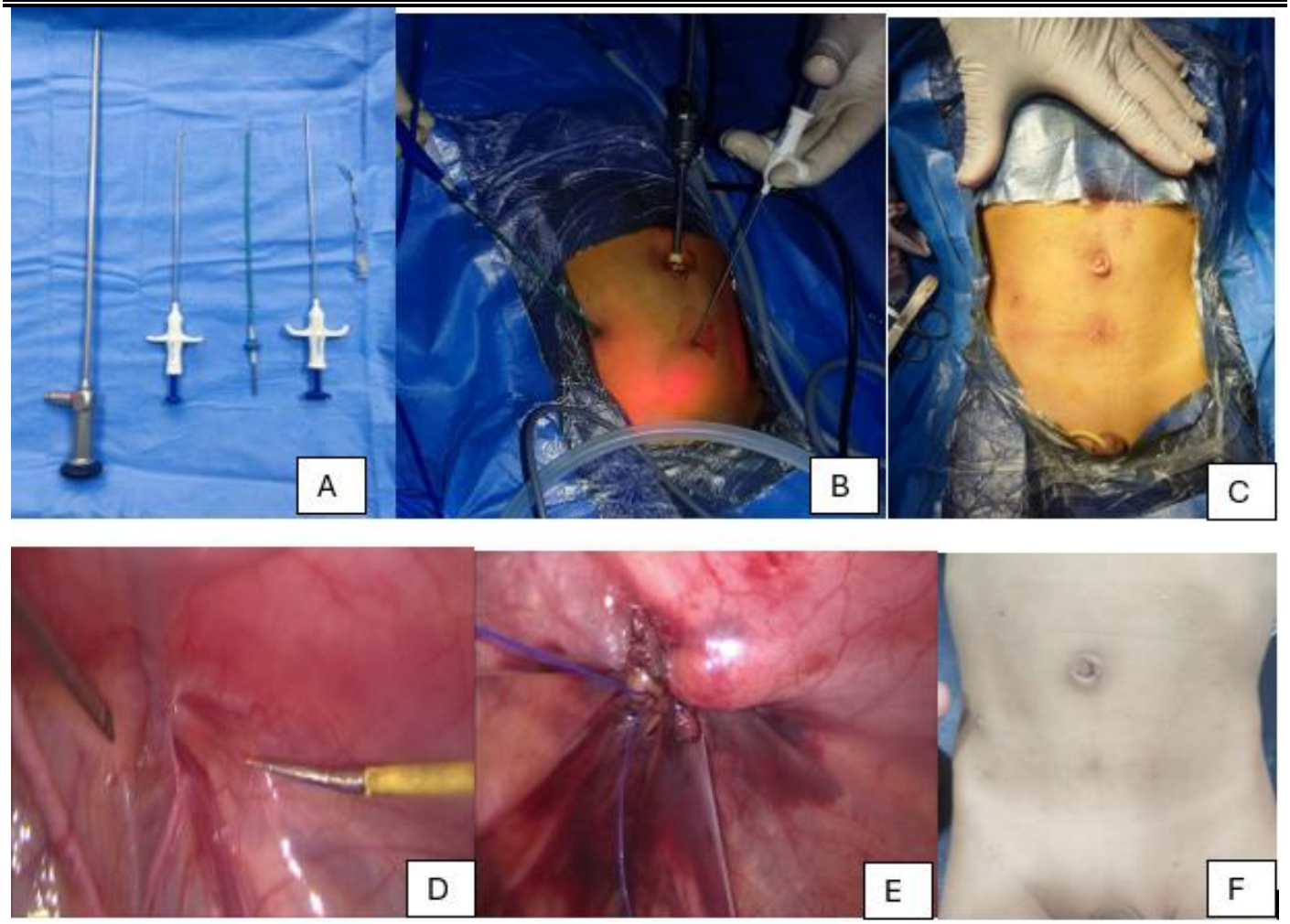

Figure [1]: Photography of needlescopic technique. A. instrument used in the technique. B. port placement. C. port site immediately post-operative. D. dissection of hydrocele sac. E. suturing of the peritoneum. F. two weeks' post-operative port site.

ESULTS

In the present study, both groups were matched concerning age and side of hydrocele without any statistical significance alteration between the studied groups Table [1]. The procedure time in the needlescopic group range [31 to 45 min], with a mean of 37.3 min. While open groups ranged from 28 to 45 minutes with a mean of 34.8 minutes without any statistically significant contrast between studied groups. In the needlescopic group, we didn't encounter any bleeding event; in the open group, we encountered two without any statistically significant difference between the studied groups. The open group showed a statistically significant incidence of scrotal edema and groin swelling. No recurrence cases were reported. The needlescopic group was associated with statistically higher cosmetic appearance than the open group.

Table [1]: Demographic Data of studied groups

		Needlescopic Group	Open Group	P value
Age [years] [mean±SD]		4.7±1.5	4±1.2	0.13
Side	Right	10 [50.0%]	9 [45.0%]	0.9
[n,%]	Left	6 [30.0%]	7 [35.0%]	
	Bilateral	4 [20.0%]	4 [20.0%]	

Table [2]: Operative data of studied groups

		Needlescopic Group		Open Group		P value
		Mean	**SD**	**Mean**	**SD**	
Procedures time [min]		37.3	4	34.8	5.7	0.1
		N	**%**	**N**	**%**	
Bleeding	No	20	100	2	90	0.2
	Yes	0	0	18	10	

Table [3]: Comparison of postoperative data of studied groups:

		Needlescopic Group		Open Group		P value
		N	%	N	%	
Scrotal edema	No	20	100	15	75	**0.02***
	Yes	0	0	5	25	
Groin swelling	No	20	100	16	80	**0.04***
	Yes	0	0	4	20	
Wound Infection	No	20	100	18	90	0.2
	Yes	0	0	2	10	
Recurrence	Yes	0	0	0	0	-

Table [4]: Comparison of Cosmetic outcome of studied groups:

		Needlescopic Group		Open Group		P value
		N	%	N	%	
Cosmetic appearance	Good	0	0	5	25	**0.01***
	Very good	2	10	15	75	
	Excellent	18	90	0	0	

DISCUSSION

The incidence of pediatric congenital hydroceles is approximately 5.7%, and numerous categories delineate the pathophysiology [5]. Children with a communicating hydrocele differ from adults, and straightforward high closure of the processus vaginalis can yield good outcomes [6].

This study aims to assess the safety and effectiveness of needlescopic hydrocelectomy in managing congenital hydrocele in children. The optimal timing for congenital hydrocele excision is debated, as most persistent patent processus vaginalis will resolve spontaneously within one to two years. Consequently, majority of pediatric surgeons may refrain from performing hydrocele surgery within the first one– two years of life except a hernia cannot be ruled out [7].

The study participants were between 2 and 7 years, with a mean age of 4.7 years for the needlescopic group and 4 years for the open group. Retrospective research, including 1,332 boys with hydrocele, was described, comprising 382 instances in the open surgery group and 950 cases in the LR group across two locations. The authors contend that laparoscopic surgery [LR] offers more significant benefits than traditional open surgery [OR] in minimizing both operative and inpatient duration, as well as in decreasing incision size [3].

Laparoscopic Percutaneous Extraperitoneal Closure [LPEC] eliminates the necessity of dissecting the inguinal canal, significantly decreasing the duration of the procedure [8]. Unlike the previously mentioned results, our analysis of operative time showed no difference between the two groups. However, the needlescopic group had a longer operative time than the open group [37.3 vs 34.8 min]. According to a systematic review and meta-analysis by **Chen *et al.*** [9], the mean operating time for unilateral LPEC was 19.56 minutes [range 8.30–41.19 minutes], whereas, for bilateral LPEC, it was 27.23 minutes [range 12.80–48.19 minutes].

The conventional operating room surgical technique requires initial access to the inguinal canal to locate the persistent processus vaginalis for high closure and inversion of the tunica vaginalis. The lumen of the sheath process tube in pediatric hydrocele is often narrow, accompanied by a tendril-like venous plexus located anteriorly to the spermatic cord, which encompasses the vas deferens, arteries, and the surrounding cremaster muscle. The diminutive size of the vaginal process tube can complicate its identification during surgery, hence increasing the risk of inadvertently injuring the spermatic cord blood vessels, vas deferens, cremaster, and other structures. Postoperatively, localized hemorrhage, edema, and scar adhesion frequently occur, with severe instances potentially resulting in testicular atrophy [9]. Moreover, the PPV wall is fine structure; excessive separation force can readily cause it to tear. The aforementioned are predisposing risk for postoperative problems and recurrence [10].

In the study by **Elhaddad *et al.*** [5], scrotal edema in the Open group six months' post-operation was ten percent due to incomplete removal or turnover of the tunica vaginalis. Furthermore, when the adhesion surrounding the PPV was pronounced, the operator encountered challenges in elevating it, resulting in imprecise ligation or positioning at a lower site.

In agreement with previous studies, the open group showed a statistically significant incidence of scrotal edema and groin swelling. Also, we encountered two cases of minor bleeding in the open group. **Liu *et al.*** [11] observed that the persistence of scrotal edema in the open group [10%] was considerably more significant than in the Laparoscopic group.

The laparoscopic lens functions to provide magnification. The surgeon can obviously differentiate the spermatic vein and vas deferens within the abdominal cavity to avert damage to surrounding tissue [5]. The PPV can be entirely ligated and sealed despite the suture needle penetrating the peritoneum at multiple sites. This is more beneficial for patients and minimizes harm to adjacent tissues [8].

This study employed an abdominal wall suture device with an epidural needle for LPEC to manage communicative hydrocele in males. **Liu *et al.*** [12] employed a modified Kirschner pin for single-port LPEC to manage 81 pediatric hydrocele cases, with all patients attaining favorable outcomes. Moreover, numerous surgeons have asserted that homemade hernia needles, epidural puncture needles, syringe needles, and other suturing instruments have exhibited significant satisfying results [13].

A retrospective review of clinical data from two distinct surgical techniques posited that ligation of the processus vaginalis [PV] in children with communicative hydrocele effectively minimizes the postoperative recurrence rate [7].

The incision following laparoscopic surgery is aesthetically pleasing and concealed, essentially resulting in scarless surgery, which exemplifies the principles of minimally invasive techniques, a fact that is valued by the parents of the children [5].

In this study, Needlescopic group was associated with a statistically

higher cosmetic appearance than the open group. Minimizing recurrence continues to be a significant clinical problem. The primary reasons for recurrence are improper ligation or the loosening of ligatures [3].

The incidence of recurrence following laparoscopic hydrocelectomy has been documented as 0–1.4% [14].

In our study, there were no cases of recurrence in both groups. The needlescopic technique allows for superior visualization, ensuring complete excision of the hydrocele sac. Full dissection of the internal inguinal ring prevents any hidden remnants from persisting. In the study by **Choi *et al.*** [15], recurrence was in one case 0.7% percentage in the trans scrotal incision approach group, while the overall recurrence incidence for their study was 0.2 percentage when comparing scrotal approach with total laparoscopic hydrocelectomy [TLH]. In the study by **Liu *et al.*** [11], six instances of hydrocele recurrence in the open hydrocelectomy group [6.67%], while no recurrences were observed in the Laparoscopic hydrocelectomy group. The incidence of hydrocele recurrence in the open hydrocelectomy group was statistically higher than in the Laparoscopic hydrocelectomy group.

Our findings concur with the study by **Elhaddad *et al.*** [5], indicating no incidence of hydrocele recurrence following total laparoscopic hydrocelectomy for all variants. The laparoscopic procedure is straightforward, with a brief and manageable learning curve [13]. Notably, a significant feature of laparoscopy is its ability to identify the contralateral PPV [5].

In conclusion, we have demonstrated that the needlescopic approach is straightforward, secure, and efficacious in treating hydroceles in children.

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None

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